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MONTHLY PROGRESS REPORT NO. 8 FOR PREIMPREGNATED ROVING STUDY

1 NOVEMBER 1961 TO 30 NOVEMBER 1961

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FORM R 18-G (PLATE)

INTRODUCTION AND SUMMARY

The following is a summary of the areas of investigation covered during this report period.

Preliminary data are presented on the effect of tension, resin content, and mandrel diameter on resin migration. The aging study, an investigation of the effect of storing preimpregnated roving at deep-freeze temperature and of the effect of various process parameters, was completed and the new data were added to the graphs. A repeat test of the tensile strength of uncured strand taken from a high resin content lot was made and is discussed. The status of other areas of investigation on which work was performed but on which no data has been obtained is also covered.

DISCUSSION

In the progress report for September (Report No. 6), data were presented on the tensile strength of preimpregnated, uncured strand. In this series of experiments, resin content of the strand was also measured and an attempt made to correlate the properties. It was noted that the high resin content material had a comparatively low tensile value and that this could not be explained by the higher resin content. Another sample of material from the same lot was tested to confirm the previous results. The following data was obtained using the same test procedure.

Spool No.	587
Resin Content	27.0 percent
Tensile Strength	82.4 pounds (average of 10 specimens)

During this test the strand broke in a progressive manner. That is, not all of the 20 ends failed simultaneously. The peak load during the test was reached with some of the filaments intact. This is similar to the type of failure, previously reported, experienced on spool number 589-1. The evidence is strong that catenary was present in the glass roving used to make this batch of preimpregnated roving.

The study of storage and optimum process parameters for preimpregnated roving was completed. The last of the planned tests on roving stored in the deep-freeze were performed. The results were added to, and are shown on, the accompanying graph (Fig. 1). It is evident that no degradation of the preimpregnated roving stored at deep-freeze temperatures

has taken place. Also, no appreciable loss in tackiness of the roving was observed. The samples used for this work were the standard 3 in. diameter by 6 in. long cylinders described earlier in the program. Testing consisted of hydrostatic burst performed at room temperature. The unidirectional hoop tensile strength values are based on the hoop fiber reinforced thickness of the resin-fiberglass composite structure.

Studies of the combined effects of roving resin content and tension, as they effect resin migration, were continued. In this study, winding was performed on 3-, 8-, and 13-in. diameter mandrels at 12, 18, and 24 lb of tension using roving having approximately 19 and 24 percent resin content. In addition, winding was performed on 3-in. diameter mandrels at 6, 12, 18 and 24 lb of tension, using roving having four different resin contents. Measurements of resin content were made on specimens as received and after removal of the surface resin. This is resin that has migrated to the surface of the filament-wound laminate as a result of the pressure applied by the roving wound under tension. The data are presented in graphical form in the accompanying Fig. 2 and 3.

Resin migration, as presented, is determined as follows:

$$\text{Resin Migration, percent} = \frac{RC_1 - RC_2}{RC_1} \times 100$$

where

RC_1 = Resin Content of the specimen as received, percent

RC_2 = Resin Content of the specimen after removal of the migrated surface resin, percent

The graphs clearly indicate that migration increases with tension and also is greater on smaller diameter mandrels. It is significant that the percent of resin migration drops considerably more when the mandrel diameter is increased from three to eight inches than from eight to thirteen inches. This indicates that further increases in mandrel diameter will have less of an effect upon the amount of resin migration. It is also apparent that as the size of the mandrel increases, resin migration is effected less by changes in tension. No significant relationship is apparent between resin content in the roving and the percent of resin migration. This is because fabric used in the construction of the cylindrical specimens has a resin content (approximately 20 to 22 percent) different from that in the roving. Also the resin in the fabric did not necessarily have the same flow characteristic as the resin in the roving. In specimens planned for future experiments the same preimpregnated roving used for circumferential windings will be used for longitudinal filaments in place of the fabric.

The preceding is the preliminary investigation of resin migration. It is hoped that additional experiments in process will establish a relationship between migration and hoop tensile stress. These experiments consist of measuring the resin content of the inner and outer layers of both thin- and thick-walled filament-wound 3 in. diameter cylinders which have been hydrostatically tested. Results of this work should be available for the next monthly report.

Performance of the study of the effect of tackiness of the roving on the ability to wind an unstable pattern has been delayed because of previous commitments on the winding equipment.

Specially wound package materials have been received for performance of the study of package design.

Preparations for the winding of ABL configuration cases in the numerically controlled winding equipment is nearing completion. A control punched tape has been completed and is ready for checkout in the winding machine. Winding of ABL cases will be performed in the study of voids content and pattern accuracy as it effects the strength of the filaments-wound structure.

PROJECTED COURSE OF ACTION

During the coming month it is planned to take action on the following items:

1. Thick-walled 3-in. diameter cylinders will be fabricated for the resin migration studies. Resin contents of the inner layers and outer layers of these and existing thin-walled samples will be performed.
2. Cylindrical samples will be fabricated using preimpregnated roving from two different package configurations. For some of the samples tension will be applied at the spool and for others tension will be applied on the strand. The effects on the material and strength of the samples will be determined.
3. The study of the effect of tackiness on winding unstable patterns will be completed.

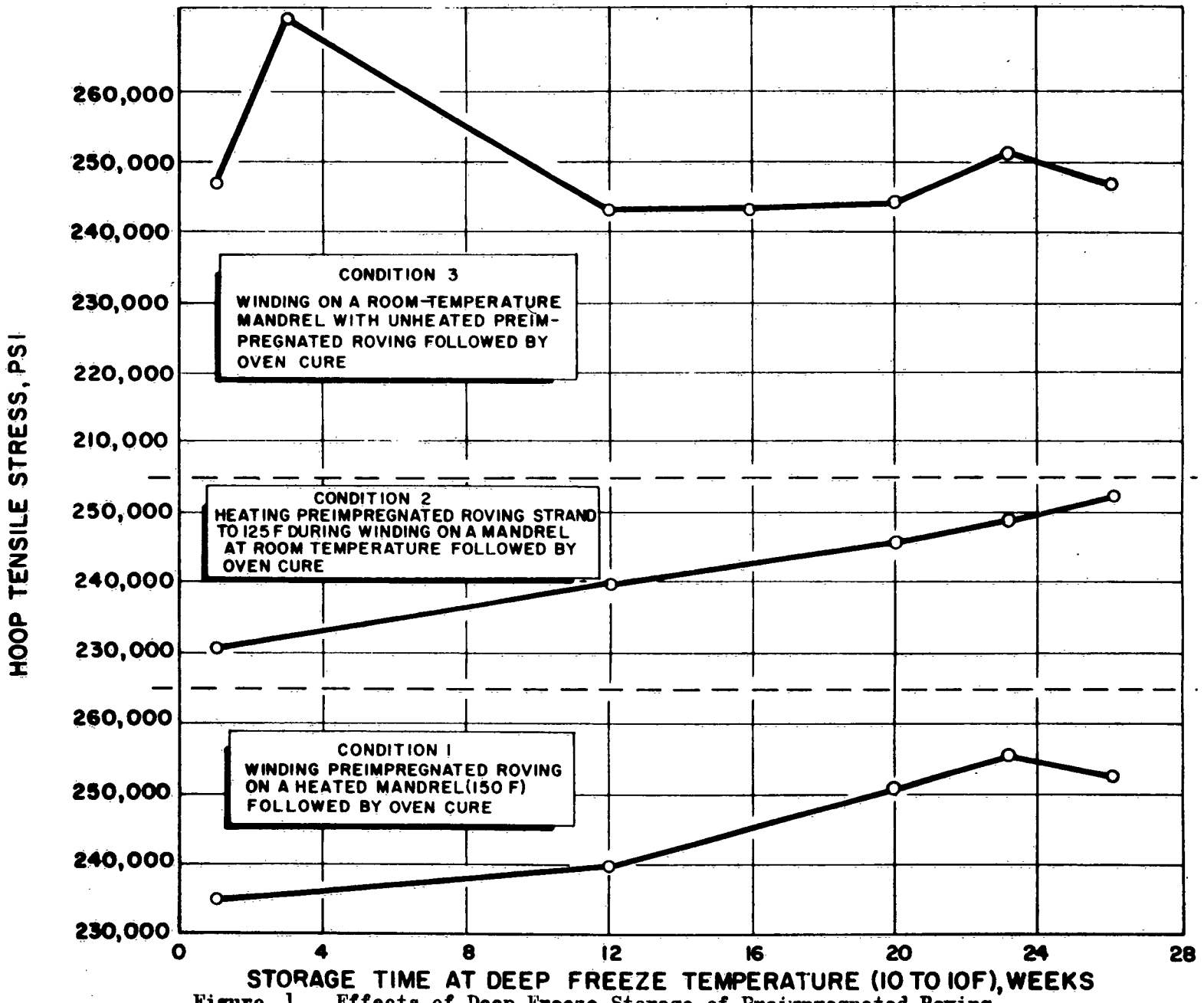

Figure 1. Effects of Deep Freeze Storage of Preimpregnated Roving and Process Parameters on Hoop Tensile Strength

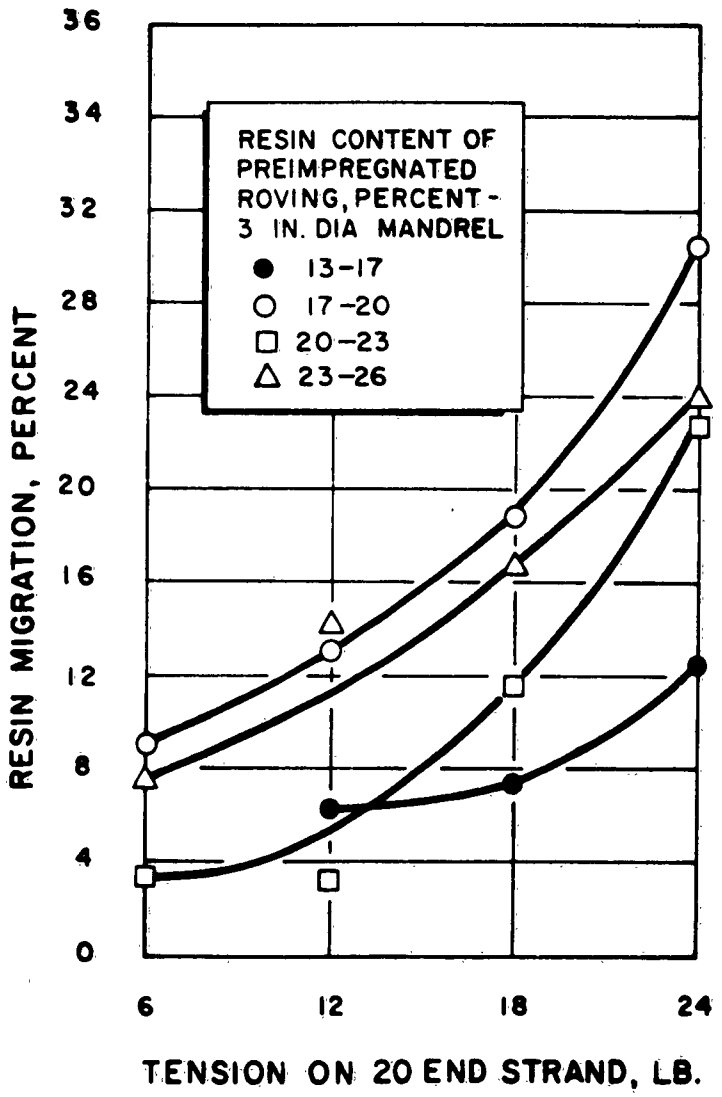

Figure 2. Effect of Tension and Roving Resin Content on Resin Migration

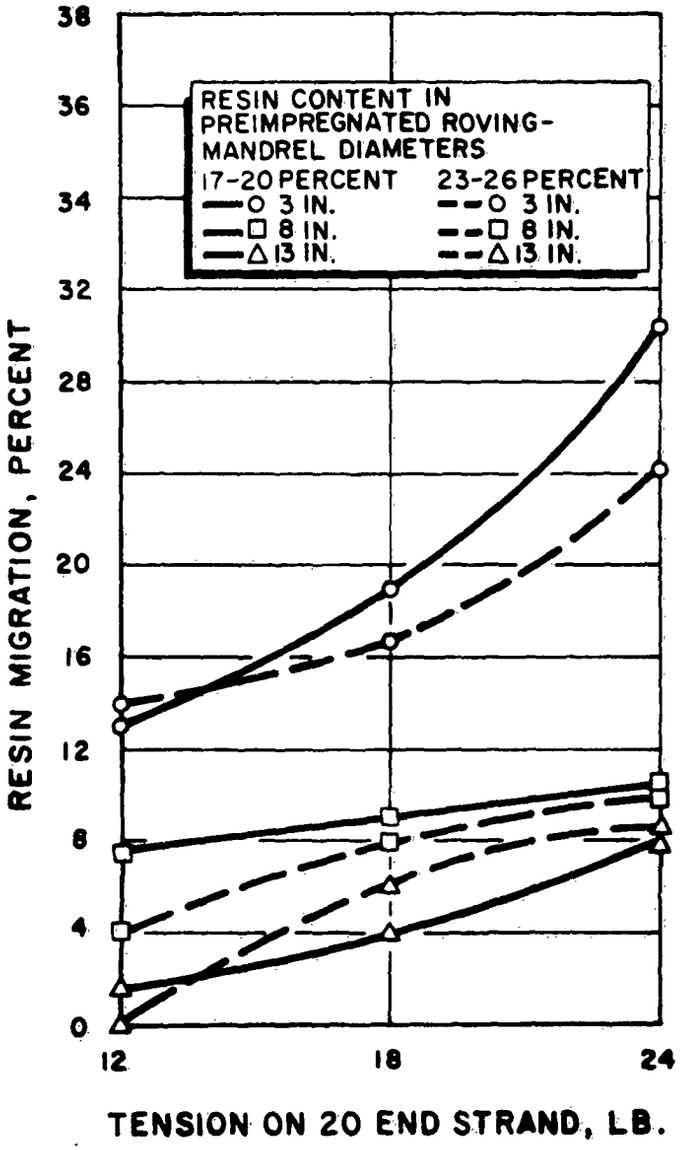

Figure 3. Effect of Mandrel Diameter and Roving Tension on Resin Migration